DOCUMENT RESUME

ED 045 403 SE 010 131

AUTHOR	Knaack, Janey
TITLE	Interdisciplinary Outdoor Education, Behavior of Mealworms.
INSTITUTION	Shoreline School District 412, Seattle, Wash.
SPONS AGENCY	Bureau of Elementary and Secondary Education (DHEW/OE), Washington, D.C.
PUB DATE	68
NOTE	56p.
AVAILABLE FROM	Outdoor Education, Shoreline School District No. 412, Northeast 158th and 20th Ave., N.E., Seattle, Washington 98155 ($0.50)
EDRS PRICE	EDRS Price MF-$0.25 HC Not Available from EDRS.
DESCRIPTORS	Biology, *Elementary School Science, Environmental Education, *Outdoor Education, *Resource Materials, *Science Activities, *Teaching Guides
IDENTIFIERS	ESEA Title III, Mealworms

ABSTRACT

This manual is intended for use by second grade teachers as a guide for 35 activities for the study of the behavior of mealworms. The activities are intended to help instill in pupils a joy and excitement for inquiry and experimentation, plus an appreciation and understanding of basic scientific methods. Introductory subject material includes a description of the major processes of science, major units of study, and an outline of the behavior and characteristics of the mealworm. Reference lists include books for teacher and pupil use, audio-visual aids, and a list of useful equipment and supplies. This work was prepared under an ESEA Title III contract. [Not available in hardcopy due to marginal legibility of original document.] (PR)

EDO 45403

INTERDISCIPLINARY OUTDOOR EDUCATION

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BEHAVIOR OF MEALWORMS

3E 010 131

..INSECTS..
!!!!BEETLES!
..SCIENCE//
!! FUN!!
LEARNING..
" " BIOLOGY"
BUGS ////
.... WORMS
PETS" " "
.... SCIENCE
" FOOD /// "
.. INSECTS ..
ACTIVITY !
... BUGS ..
!!BEHAVIOR!!
" BEETLES" "
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" " "

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AN INTERDISCIPLINARY OUTDOOR EDUCATION PROGRAM

Under Provisions of Public Law 89-10, Title III

OE Project No. 66-2682

Project: The Behavior of Mealworms

by

Janey Knaack

Shoreline School District No. 412

King County

Seattle, Washington

1968

INTRODUCTION

WHY WE TEACH SCIENCE

The central purpose of teaching science is to arouse in the child, whether or not he will become a professional scientist, a sense of joy and excitement experienced through his own discoveries and scientific experimentation. Education in science should enlarge the child's appreciation of his world; it should also lead him to a better understanding of the range and limits of man's control over nature. Whatever the problem in science, the child's ability to observe can be extended so that he understands the wide range of observation possible even when simple phenomena are under study. He must learn to order the evidence of all his senses.

Science seeks to describe events of our natural environment. As teachers, we should be able to supply the incentive necessary for children to become aware of this environment. One of the major objectives of elementary science teaching should be to help the child understand generalizations or principles which will allow him to solve problems in his environment. The teacher can be a source of valuable information by directing and guiding the child as he learns to manipulate his environment. The teacher helps the youngsters with the methods of science.

Another primary task of the science teacher should be to prepare the child for a scientific-oriented society. The child must be able to apply his science learnings to the world in which he lives. He must be able to use the facts of science so that they become meaningful to him. To be worthwhile, the child must look beyond pure identification. As an end product in science education, the child would then possess an increasingly accurate description of his environment and his society.

As a science teacher, we are there to give these youngsters the opportunity to explore processes; we are there to help guide them. The child will also get direction from previous experiences, but as teachers we must see that the child realizes the value of his own observations and experiences. The teacher can also help the child develop a set of skills for investigating relationships. The child can learn to gather information, to hypothesize relationships between variables and test through written and verbal experiences.

In all science experiences it is the attitude of the teacher towards inquiry, towards exploring the unknown, that is of first importance in developing a scientific approach. Just providing science experiments is not enough. "Curiosity grows on the soil of approval." It dies if not encouraged and developed.

PERSONNEL

The interdisciplinary booklet on "Behavior of Mealworms" was coordinated and developed by the following:

NAME	PRIMARY RESPONSIBILITY	
District Personnel		Level
Miss Jane C. Knaack	Author	Elementary
Mr. Edgar F. Neal	Project Leader	
Mrs. Lee Broad	Production and Layout	
Mrs. Diane Prestebak	Production and Layout	
Pauline M. Swaney	Production and Layout	

TABLE OF CONTENTS

Title	Page
INTRODUCTION	i
MAJOR PROCESSES OF SCIENCE	1
MAJOR UNITS OF STUDY	2
"BEHAVIOR OF MEALWORMS"	3
CONCEPT	4
BEHAVIOR OF MEALWORMS	
Activity #1	7
Activity #2	8
Activity #3	9
Activity #4	10
Activity #5	11
Activity #6	12
Activity #7	13
Activity #8	14
Activity #9	15
Activity #10	16
Activity #11	17
Activity #12	18
Activity #13	19
Activity #14	20
Activity #15	21
Activity #16	22
Activity #17	23
Activity #18	24
Activity #19	25
Activity #20	26
Activity #21	27
Activity #22	28
Activity #23	29
Activity #24	30
Activity #25	31
Activity #26	32
Activity #27	33
Activity #28	34
Activity #29	35
Activity #30	36
Activity #31	37
Activity #32	38
Activity #33	39
Activity #34	40
Activity #35	41

Title	Page
SUPPLEMENTARY ACTIVITIES	42
BOOKS FOR THE TEACHER	44
BOOKS FOR THE PUPIL	45
PICTURES FOR THE PUPIL	45
AUDIO-VISUAL AIDS	46
SCIENCE EQUIPMENT AND SUPPLIES	47

MAJOR PROCESSES OF SCIENCE

Second Grade Level:

1. Observation:

   To be able to make the distinction between qualitative and quantitative observations.

   To be able to discriminate between description and interpretation.

2. Experimentation:

   To be able to formulate a hypothesis to explain a given phenomena.

   To be able to design an experimental procedure to be used to prove or disprove a hypothesis.

   To be able to identify the processes involved in conducting an experiment.

   To be able to perform an experimental investigation according to a systematic procedure previously constructed.

3. Interpreting Data:

   To be able to collect valid data as experimentation is taking place.

   To be able to form logical conclusions from previously collected data from observations and experiments.

   To be able to recognize the possibility of experimental error present in data.

4. Discussion:

   To be able to discuss with the class questions which have been aroused through observations and experimentation.

   To be able to formulate a theory and hypothesize through questions working under the "Inquiry" process.

MAJOR UNITS OF STUDY

Second Grade Level:

Unit 1: ANIMALS

Animals live in different places.
Animals depend on the living things found in their environment for food.
Animals must take care of their babies.
Some animals are alike and some are different.
Some animals are too small for our eyes to see.

Unit 2: WATER AND AIR

Water is a colorless, tasteless, odorless liquid.
Water does not have a shape of its own.
Water takes up space and has weight.
Some things float in water, others sink.
Air is all around us all the time.
Air takes up space and has weight.
Air presses on an object in all directions.
The atmosphere presses down on all objects.

Unit 3: SOUND AND LIGHT

Some sounds are soft and some are loud.
Sounds are made in different ways.
Sounds are produced when things vibrate.
Sounds travel through air, solid objects, and water.
Light travels much faster than sound.
Light bounces back from a shiny surface.
Light bends when it passes through water or a lens.

Unit 4: HEAT

Temperature is a measure of the "hotness" or "coldness" of a substance.
Heat changes the temperature of a substance.
Electricity is a source of heat.
Heat makes solids, gases, and water expand.
Heat travels through solids by conduction.
Heat travels through air and water chiefly by convection.
Heat travels through space by radiation.

"BEHAVIOR OF MEALWORMS"

I. Mealworms are a small living organism.

- A. General body structure
- B. Sensory perception
- C. Care of mealworms

II. Mealworms have distinctive behavioral characteristics.

- A. Patterns of locomotion
- B. Eating habits
- C. Environment and natural habitat

III. Mealworms have a unique life history.

- A. Mealworms as grain beetles
- B. Life cycle of the mealworm
- C. Mealworm cultures

IV. Mealworms are members of the insect family.

- A. Characteristics of insects
- B. Comparing mealworms with the mealworm beetle
- C. Significance of mealworm studies

CONCEPT:

"BEHAVIOR OF MEALWORMS"

I. Mealworms are a small living organism.

A. General body structure (Activity #1)
1. The body of the mealworm is composed of 13 sections which are covered with tiny hairs.
2. The mealworm has six legs with clawlike feet.
3. The mealworm has two eyes and two antennas.
4. The tips of the tail differ from one specimen to another; varying from a fanlike to a pointed shape.

B. Sensory perception (Activity #2)
1. The mealworm uses his organs of sight and touch in response to stimuli.
2. The mealworm will respond to bright lights. (Activity
3. Because of his fine hairs on his legs and sides of his body, the mealworm is very sensitive to heat. (Activity #4)

C. Care of mealworms (Activity 5 and 6)
1. For studies of behavior the mealworms must be active.
2. Mealworms need bran for food, a small amount of water, and light as well as dark places.
3. Mealworms should be kept in a jar; cardboard boxes are not suitable.

II. Mealworms have distinctive behavioral characteristics.

A. Patterns of locomotion
1. The movement of a mealworm varies depending on speed and direction of travel. (Activity 7, 8, 9)
2. The mealworm moves better on a slightly rough surface, rather than a smooth surface.
3. The mealworm clings to a surface with the claws on his feet.
4. There are various types of stimuli which cause the mealworm to move backwards. (Activity 10)
5. The mealworm will turn left if he is touched on the right side. (Activity 11)
6. The mealworm has the tendency to follow walls. (Activity 12)

B. Eating habits
   1. Mealworms thrive on bran or cereal flakes for nourishment; they have definite dietary requirements. (Activity 13)
   2. They have the ability to extract water from carbohydrates in their food. (Activity 14)
   3. The mealworm discovers his food source by chance alone. (Activity 15 and 16)

C. Environment and natural habitat
   1. Mealworm usually collect in an area of low humidity. (Activity 17)
   2. The mealworm will seek dark places. (Activity 18 and 19)
   3. Mealworms prefer warm areas rather than extreme cold or heat. (Activity 20)

III. Mealworms have a unique life history.

A. Mealworms as grain beetles
   1. Mealworms are the larvae of the large black beetles belonging to the genus Tenebrio. (Activity 21)
   2. Two species are common, the yellow mealworm (Tenebrio molitor) and the dark mealworm (Tenebrio obscurus). (Activity 22)
   3. Both species are of European or Asiatic origin.

B. Life cycle of the mealworm
   1. There are four distinct stages in the life cycle, (egg, larva, pupa, and adult). (Activity 23 & 24)
   2. The beetles usually live only a few months.
   3. Female beetles may lay as many as 500 eggs.

C. Mealworm cultures
   1. Mealworms live in dark damp places and are primarily scavengers. (Activity 25 and 26)
   2. Large numbers frequently gather in a place to pupate and transform into the beetle stage.
   3. A mealworm culture will continue to reproduce itself if it has a constant supply of food and some moisture. (Activity 27)

IV. Mealworms as members of the insect family.

A. Characteristics of insects
   1. All insects have six legs and three body parts. (Activity 28)
   2. Some insects change as they grow. (Activity 29)

3. Almost all insects lay eggs.
4. Some insects live alone while some live in large families. (Activity 30)

B. Comparing mealworms with the mealworm beetle
1. Like the mealworms, the beetles prefer darkness. (Activity 31)
2. The beetle and the mealworm both prefer warm areas greatly over extreme cold or heat. (Activity 32 and 33)
3. Mealworms and beetles both like the sides and corners of boxes. (Activity 34)

C. Significance of mealworm studies
1. Mealworms are used for fish bait and as food for birds and small mammals.
2. They can be destructive in large numbers by invading bags of feed, grain, flour and similar materials.
3. Mealworms can be studied easily because they exhibit reasonably consistent and definite behavior. (Activity 35)

BEHAVIOR OF MEALWORMS

Grade 2
Self.

CONCEPT: Mealworms as living organisms.

SUBCONCEPT: The mealworm's body structure has 13 segments, appendages and head parts. (I.A)

PROCESS/ES: Observation and Identification.

MATERIALS REQUIRED:

- Mealworms
- Magnifying Glasses
- Ditto Sheets-Pencils
- Rulers
- Mealworm Pictures

ACTIVITY #1:

Have the children identify the general body structure of the mealworm with the use of the magnifying glasses. Using the ditto sheet with a diagram of the mealworm, locate the head, eyes, feet, etc. on the diagram. Using the pictures, let the children examine the mealworm in detail -- shape of the tail, hair on the body, etc.

Questions:

1. Does the mealworm have eyes?
2. How many feet does it have?
3. How many body segments?
4. How long is the mealworm?
5. Are they all the same size?

BEHAVIOR OF MEALWORMS

Grade 2
*ESS - "Behavior of Mealworms

CONCEPT: Mealworms as living organisms.

SUBCONCEPT: Sensory perception - mealworm's use of sight organs. (I. B-1)

PROCESS/ES: Experimentation

MATERIALS REQUIRED:

- Mealworms
- Box
- Fluorescent Paint
- Flour

ACTIVITY #2:

Use this experiment to find out whether mealworms use their eyes. Put the mealworm in a box in a pitch dark place. Put a fluorescent dot of paint on him and follow his movements, or put flour in the box to follow his tracks.

Questions:

1. Can the mealworm still follow a wall in the dark?
2. Does he need to see where he is going?
3. Do you think the mealworm uses his eyes for direction?

*"Behavior of Mealworms." Elementary Science Study. New York: McGraw Hill, 1966.

BEHAVIOR OF MEALWORMS

Grade 2
ESS - "Behavior of Mealworms"

CONCEPT: Mealworms as living organisms.

SUBCONCEPT: Sensory perception - mealworms respond to bright lights. (I. B-2)

PROCESS/ES: Discovery Approach

MATERIALS REQUIRED:

Mealworms
Flashlight
Box

ACTIVITY #3:

Put some mealworms on the table. Shine the flashlight on their eyes. Observe the movement of the mealworm. Lower a large box over the head of a student with his eyes closed. Can you tell when it becomes darker as the box is lowered?

Questions:

1. Is it possible to see just light and dark?

2. Do you think a mealworm can see as you can?

3. Why or why not?

4. How else could we test to see if the mealworm responds to bright lights?

BEHAVIOR OF MEALWORMS

Grade 2
Self

CONCEPT: Mealworms as living organisms.

SUBCONCEPT: Sensory perception - mealworms are very sensitive to heat. (I. B-3)

PROCESS/ES: Experimentation

MATERIALS REQUIRED:

Match
Water
Beaker
Black cloth
Thermometer

ACTIVITY #4:

Have the children experiment to discover what the mealworm does when he comes in contact with extreme heat:

1. Light the match; hold the match slightly away from the front of the mealworm; away from the back too.

   What is his reaction?

   Why do you think he is so sensitive?

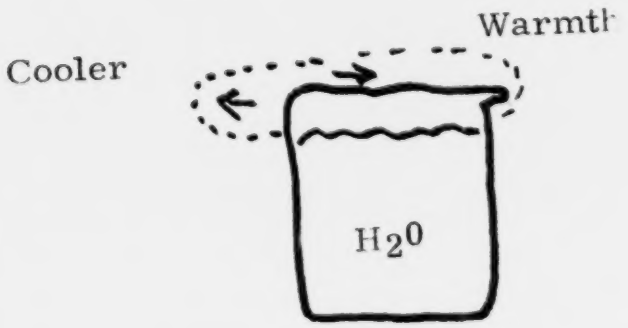
   How does he move away from the match?

2. Fill the beaker with boiling water; cover the beaker with a black cloth. Allow the cloth to warm up. Place the mealworm in the middle of the beaker.

   In what direction does he move?

   How is his body affected by the extreme heat?

   What is another method that could test this idea?



BEHAVIOR OF MEALWORMS

Grade 2
ESS - "Behavior of Mealworms"

CONCEPT: Mealworms as living organisms.

SUBCONCEPT: Mealworms need a particular type of care. (I. C)

PROCESS/ES: Experimentation

MATERIALS REQUIRED:

Mealworms
Bran or Cereal
Jars
Other food substances

ACTIVITY #5:

Have the children experiment with the food preferences of the mealworms. In four different jars, put one mealworm and some different type of food in it. In the fifth jar, put some bran with the mealworm. Watch the mealworms; what kind of food is being eaten by them, what kind of food will they not touch? (For example, one group of children found that mealworms positively did not like dog food and baby food.)

Questions:

1. What kind of food did the mealworms like best?

2. How do you know they liked this type?

3. Which kind would they not eat?

BEHAVIOR OF MEALWORMS

Grade 2
ESS - "Behavior of Mealwor

CONCEPT: Mealworms as living organisms.

SUBCONCEPT: Mealworms need a particular type of care. (I. C)

PROCESS/ES: Observation

MATERIALS REQUIRED:

Mealworms
Cardboard Box
Jar

ACTIVITY #6:

For an observation experience, put several mealworms in a jar and several mealworms in a cardboard box. Watch the two different containers with the mealworms for several days. What happens to the cardboard box?

Questions:

1. Did the mealworms stay in the box or did they chew their way through the bottom?

2. What is the advantage of using a jar container?

3. What is the best type of care for mealworms?

BEHAVIOR OF MEALWORMS

Grade 2
ESS - "Behavior of Mealworms"

CONCEPT: Mealworms - their behavioral characteristics

SUBCONCEPT: Locomotion - the movement of a mealworm varies.
(II. A-1)

PROCESS/ES: Student Demonstration

MATERIALS REQUIRED:

Mealworms
Magnifying Glasses

ACTIVITY #7

While some of the children actually observe the walking habits of the mealworm, have three children stand in a row demonstrating different ideas how a mealworm walks with their pairs of legs.

Questions:

1. Can a mealworm walk in a straight line?

2. In what order does the mealworm move its legs?

3. How does a mealworm use his legs when he turns?

BEHAVIOR OF MEALWORMS

Grade 2
ESS - "Behavior of Mealworms"

CONCEPT: Mealworms - their behavioral characteristics

SUBCONCEPT: Locomotion - the movement of a mealworm varies. (II. A-1)

PROCESS/ES: Observation

MATERIALS REQUIRED:

Mealworms
Mirror
Plastic Box
Magnifying Glasses

ACTIVITY #8

The children are to examine and observe the walking movements of the mealworm, using the above equipment. The movement can be observed by putting the mealworm on a mirror or in a plastic box. Using the plastic box, have the child look underneath the mealworm as he walks.

Questions:

1. Does a mealworm turn more often to the right or to the left?

2. How fast can a mealworm walk?

3. Is the mealworm able to walk on a smooth surface like the mirror?

BEHAVIOR OF MEALWORMS

Grade 2
Self

CONCEPT: Mealworms - their behavioral characteristics

SUBCONCEPT: Locomotion - the mealworm clings to a surface with the claws on his feet. (II. A-3)

PROCESS/ES: Experimentation

MATERIALS REQUIRED:

Board - 18/18 Inches
Mealworms
Sheeting

ACTIVITY #9:

Cover a flat surface board with a piece of sheeting. Place #1 mealworm in the center of the board. Record the mealworm's activity. Elevate the board end to a 30 degree angle. Place the mealworm in the center and observe the direction of movement; then record the pattern. Repeat these procedures with another specimen. Repeat the experiment with a bare board.

Questions:

1. In which direction does the mealworm move?

2. Does the mealworm seem to move better on the covered board or on the bare board?

3. How does he use his claws to help his movement on the board?

BEHAVIOR OF MEALWORMS

Grade 2
ESS - "Behavior of Mealworn

CONCEPT: Mealworms - their behavioral characteristics

SUBCONCEPT: Locomotion - the backward movement of a mealworm is dependent upon various stimuli. (II. A-4)

PROCESS/ES: Experimentation

MATERIALS REQUIRED:

Mealworms
Nail (Matches)
Pin
Pencils
Water
Vinegar
Data Sheet
Eye Droppers

ACTIVITY #10:

Have the children construct an experimental procedure to answer the question - "Which is the best way to make a mealworm move backwards?" Have them test the different types of methods that make the mealworm move backwards, such as touching his antennae with a pin, blocking with the hand, mealworm at the edge of paper. Each method should be tested with a number of trials. Data is to be recorded noting the number of times tried, and the number of times the mealworm moved backwards. After the testing has been completed, compare the students' findings to determine which is the best way to make a mealworm move backwards.

DATA SHEET

What was done	Times Tried	Times Backwards
Hot Nail	20	16
Pin	20	18
Blocking with hand	15	7
Flashlight	15	9

BEHAVIOR OF MEALWORMS

Grade 2
Self

CONCEPT: Mealworms - their behavioral characteristics.

SUBCONCEPT: Locomotion - the mealworm will turn left if he is touched on the right side. (II. A-5)

PROCESS/ES: Observation and Experimentation

MATERIALS REQUIRED:

Mealworms
Toothpicks
Record Sheet

ACTIVITY #11:

Have the students work in partners with two mealworms. One child will do the testing of the mealworm's reactions, while the other child records the findings. Put the mealworm on the table. Touch him on the right side. What direction does he turn?
Repeat this procedure more than once, alternating touching him on the right and left sides. What did you discover?

BEHAVIOR OF MEALWORMS

Grade 2
ESS - "Behavior of Mealwor

CONCEPT: Mealworms - their behavioral characteristics.

SUBCONCEPT: Locomotion - the mealworm has a tendency to follow walls. (II. A-6)

PROCESS/ES: Experimentation and Construction

MATERIALS REQUIRED:

Mealworms
Cardboard
Plywood
Paper Clips
Hammer and Nails
Glue
Magnifying Glasses

ACTIVITY #12:

After discussion about the kind of wall a mealworm might follow, have the children construct test walls at home or in school. They can be made from a variety of things, listed above. (This exercise allows children to design and make equipment to test "hunches" they might have. Students can watch the mealworms walk along the walls with magnifying glasses. Have children record data and make conclusions from these observations.

Questions:

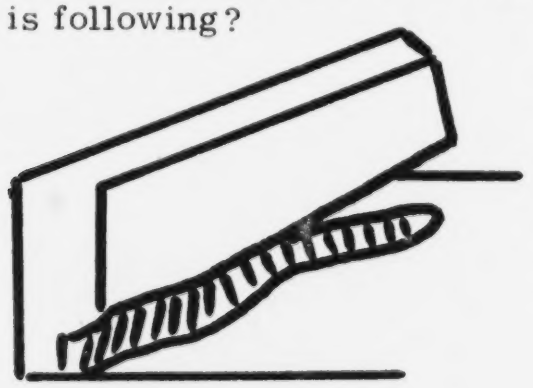
1. How does a mealworm follow the walls?

2. With his legs?

3. With his feeler?

4. With his body?

5. What does a mealworm do when it reaches the end of the wall it is following?



BEHAVIOR OF MEALWORMS

Grade 2
ESS - "Behavior of Mealworms"

CONCEPT: Mealworms - their behavioral characteristics.

SUBCONCEPT: Eating habits - mealworms have definite dietary requirements. (II. B-1)

PROCESS/ES: Experimentation and Observation

MATERIALS REQUIRED:

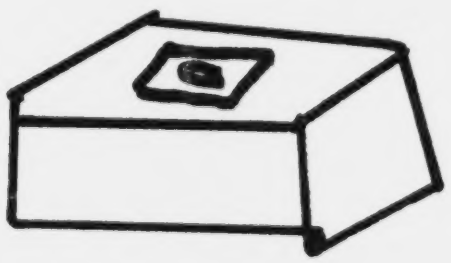
Mealworms
Bran
Window Box
Pencil Shavings
Chalk Dust
Plastic wrapping
Tape

ACTIVITY #13:

Construct a window box by cutting a small hole in the bottom of a box and then covering it with plastic wrapping taped at the edges. Put piles of bran, pencil shavings, and chalk dust in the box. Observe the actions of the mealworms.

Questions:

1. Will the mealworm show a preference for bran?
2. Do the mealworms hide under the other piles as well as bran?
3. How dark is it under the bran?
4. Do the mealworms behave differently when they are under the bran?
5. How can you make mealworms hungry?



BEHAVIOR OF MEALWORMS

Grade 2
Self

CONCEPT: Mealworms - their behavioral characteristics

SUBCONCEPT: Eating habits - mealworms extract water from carbohydrates in their food. (II. B-2)

PROCESS/ES: Observation

MATERIALS REQUIRED:

Mealworms
Two Jars
Bran
Piece of Apple
Cloth

ACTIVITY #14:

Set up the following to be observed for two days:

1. Put a mealworm and bran in jar #1.

2. Put a mealworm, bran and a piece of apple in jar #2.

Observe the actions of the two different mealworms.

Questions:

1. Is there a difference in the activity of the two mealworms?

2. Does the mealworm in jar #2 go towards the apple?

3. What does it do?

(Put a wet cloth in with jar #1; observe the mealworm's actions. Does he congregate by the cloth? Why?

BEHAVIOR OF MEALWORMS

Grade 2
ESS - "Behavior of Mealworms"

CONCEPT: Mealworms - their behavioral characteristics

SUBCONCEPT: Eating habits - the mealworm discovers his food source by chance alone. (II. B-3)

PROCESS/ES: Demonstration

MATERIALS REQUIRED:

Mealworms
Shoe Box
Bran

ACTIVITY #15:

Introduce this activity by demonstration. (It leads to a follow-up activity.) Show the class a shoe box with a pile of bran at one end. Place 20 mealworms in the other end and leave the box uncovered. For two days have the children observe the activities of the mealworms.

Questions:

1. How do the mealworms find the bran?

2. How could we find out if mealworms find the bran because they sense it or just because they happen to bump into it?

3. Does the mealworm seem to be able to go straight to the bran after he gets close?

BEHAVIOR OF MEALWORMS

Grade 2
ESS - "Behavior of Mealworr

CONCEPT: Mealworms - their behavioral characteristics

SUBCONCEPT: Eating habits - the mealworm discovers his food source by chance alone. (II. B-3)

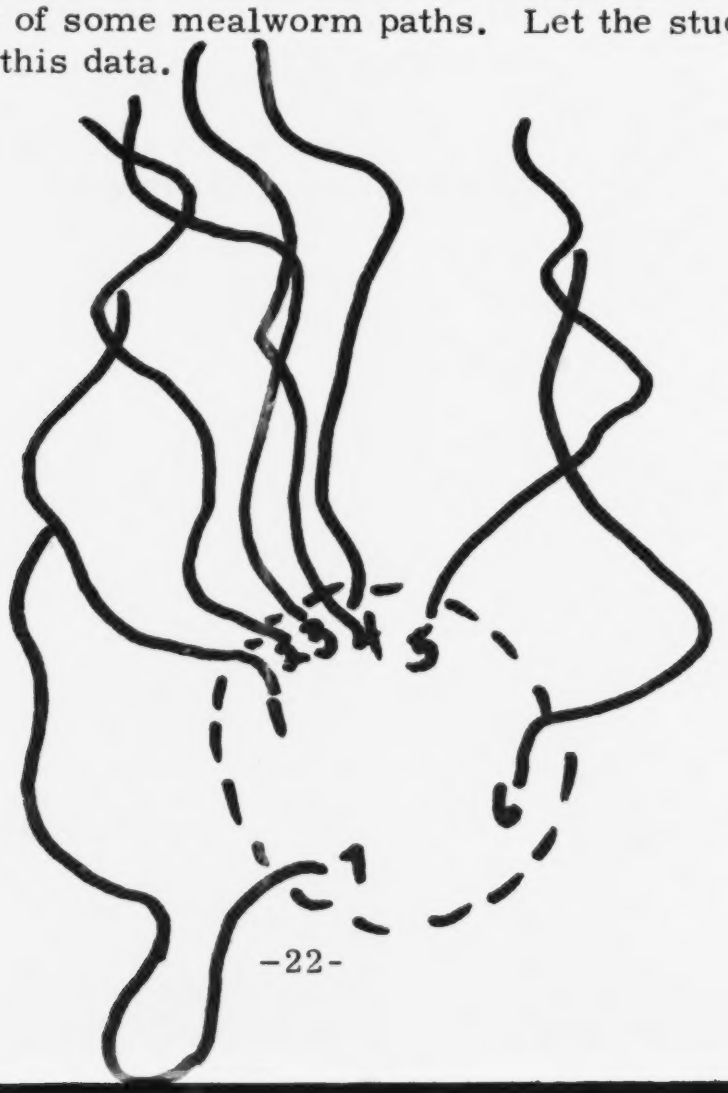
PROCESS/ES: Experimentation

MATERIALS REQUIRED:

Mealworms
Bran
Shoe Box
Worksheet

ACTIVITY #16:

This should be the follow-up activity from a classroom demonstration. Set up an experiment to determine how a mealworm finds bran. (Suggest to the children that a useful procedure is to make the mealworm's path with a pencil as it moves along.) Have the children design a worksheet; the worksheet should approximate the position of the bran and the worms in the original demonstration. Pupils then draw the mealworm's path by following it around this paper with a pencil. Several trials should be made with each of several mealworms. To compare the students' results, make a composite of some mealworm paths. Let the students draw conclusions from this data.



BEHAVIOR OF MEALWORMS

Grade 2
ESS - "Behavior of Mealworms"

CONCEPT: Mealworms - their behavioral characteristics

SUBCONCEPT: Environment - mealworms usually collect in an area of low humidity. (II. C-1)

PROCESS/ES: Experimentation

MATERIALS REQUIRED:

Piece of tubing
Paper
Data sheet - pencils
Mealworms

ACTIVITY #17:

Construct a chamber out of the piece of tubing. Put a moist piece of paper at one end to make the humidity higher on one side. By burying the length of the tubing and the amount of moisture in the paper, the mealworms are offered a variety of humidity alternatives. Put five mealworms in the chamber for one hour. At the end of each fifteen minute interval, count the number of mealworms on both the dried and moist sides of the chamber. Record this information. After each recording, move the mealworms to a new position.

Questions:

1. Did the mealworms collect on the dry or moist side of the chamber?

2. Do mealworms like an area of high or low humidity?

BEHAVIOR OF MEALWORMS

Grade 2
Self

CONCEPT: Mealworms - their behavioral characteristics

SUBCONCEPT: Environment - mealworms seek dark places (II. C-2)

PROCESS/ES: Observation and Experimentation

MATERIALS REQUIRED:

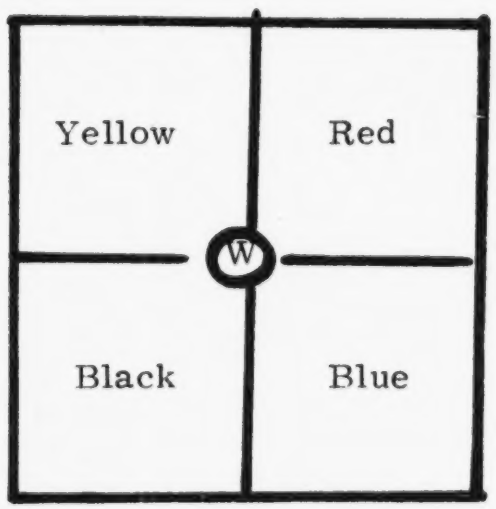
Mealworms
Colored Paper
Tabulation Sheet

ACTIVITY #18:

As a correlation experiment, let the children find out if mealworms prefer a certain color. (Correlate this to the characteristic of prefering dark places.) Have the children make a diagram on apiece of paper, as shown in the drawing. Set five mealworms in the center of the paper on the white disk. Watch the mealworms to see where they go. Do a number of tests.

Questions:

1. Which color do mealworms prefer?
2. Why do you think that they might like black better then white?
3. Which is the darkest color?
4. Which is the warmest color?



BEHAVIOR OF MEALWORMS

Grade 2
Self

CONCEPT: Mealworms - their behavioral characteristics

SUBCONCEPT: Environment - mealworms seek dark places. (II. C-2)

PROCESS/ES: Experimentation

MATERIALS REQUIRED:

Mealworms
Dark and Light Cloths

ACTIVITY #19:

Have the children take one mealworm, a piece of dark cloth and a piece of light cloth. Let the children set up their own method of experimentation to see if the mealworms prefer the light cloth or the dark cloth. For example, the mealworm can be placed in the center of the table; put the cloths some distance from him. Let him move freely in the direction that he desires.

Questions:

1. Does the mealworm move towards the dark or light cloth?
2. In what direction does he move when he is placed on the table?
3. In the jar, where does he usually stay? On top or underneath the bran?
4. Why do you think he does this?
5. Is it lighter or darker under the bran?

BEHAVIOR OF MEALWORMS

Grade 2
Self

CONCEPT: Mealworm - their behavioral characteristics

SUBCONCEPT: Environment - mealworms prefer warm areas to extreme cold or heat.

MATERIALS REQUIRED:

Beaker
Black Cloth
Thermometer
Water
Match
Mealworms

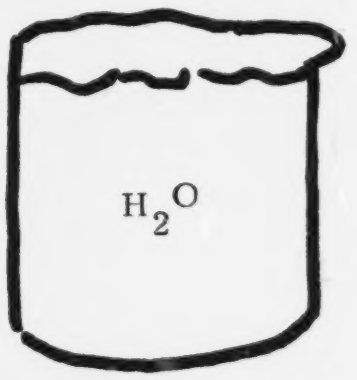
ACTIVITY #20:

Observe the reaction of the mealworm to various degrees of heat.

1. Reaction to match:
Light the match; hold it slightly away from his front. What does he do?

2. Reaction to warm temperatures:
Fill the beaker with hot water; measure the heat of the water with the thermometer. Cover the beaker with a black cloth. Allow time for the cloth to warm up. Place the worm on the edge of the beaker. Does he go towards the heat or away from it?

3. Reaction to cold temperature:
Do the same procedure as described in #2. Record his reactions. (For #2, #3 use various temperatures of warm water and cold water; which does he prefer?)



BEHAVIOR OF MEALWORMS

Grade 2
Self

CONCEPT: Mealworms - their life history

SUBCONCEPT: Mealworms are the larvae of the black, grain beetle. (III. A-1)

PROCESS/ES: Observation

MATERIALS REQUIRED:

Mealworms
Mealworm Beetles
Booklet "Mealworms"
Bran

ACTIVITY #21:

Present the class with a jar which contains both mealworms and mealworm beetles. Conduct an inquiry session.

Questions:

1. Why are there both mealworms and beetles in the jar?

2. Is there any connection between the two?

3. What happens to the mealworm when it develops into an adult?

Let the students use other resources, if necessary.

Have them try to discover the connection between the two organisms.

BEHAVIOR OF MEALWORMS

Grade 2
Self

CONCEPT: Mealworms - their life history

SUBCONCEPT: There are two common species of mealworms (III. A-2)

PROCESS/ES: Observation

MATERIALS REQUIRED:

Mealworms - Yellow Specie or Dark Specie
Magnifying Glasses
Stimuli Equipment

ACTIVITY #22:

Since the children have been working with the yellow variety of mealworms, bring some dark mealworms into the class for them to compare the two.

Questions:

1. Are the two types of mealworms completely alike?

2. What differences do you find?

3. What type of tests could you do to see if the mealworms behave the same or differently?

   Have the children use the magnifying glasses and the stimuli equipment (such as pins, straws, etc.) or various other things to watch the dark mealworm respond to various types of stimuli. Are his responses the same as the dark mealworm?

BEHAVIOR OF MEALWORMS

Grade 2
Self

CONCEPT: Mealworms - their life history

SUBCONCEPT: Life cycle - there are four stages in the life cycle. (III. B-1)

PROCESS/ES: Observation

MATERIALS REQUIRED:

Mealworms
Bran
Cloth
Wooden box with glass cover

ACTIVITY #23:

This phase of the mealworm study will continue the entire length of the unit. With the children, set up a mealworm culture. The mealworms used should be in the larva stage. Let the class observe the entire cycle of the mealworm; larva, pupa, adult, and eggs. (The beetles must have a good supply of moisture to live and lay their eggs. If the bran is left undisturbed for several weeks, the eggs will more likely hatch.)

Questions:

1. What has happened to the outside skin of the mealworm?

2. What has happened to our original mealworm?

BEHAVIOR OF MEALWORMS

Grade 2
Self

CONCEPT: Mealworms - their life history

SUBCONEPT: Life cycle - there are four stages in the life cycle (III. B-1)

PROCESS/ES: Observation

MATERIALS REQUIRED:

Mealworm Culture
Specimens of different cycles
Diagram of cycle

ACTIVITY #24:

Using the various species found in the mealworm culture, have the class observe them. Give the students a diagram of the life cycle of the mealworm. Observe the specimens with the diagram.

Questions:

1. What is the first stage of the mealworm development?
2. Describe the pupa stage.
3. What does the adult specie look like?
4. How does the transformation take place?

Adult Beetle

BEHAVIOR OF MEALWORMS

Grade 2
Self

CONCEPT: Mealworms - their life history

SUBCONCEPT: Mealworm Culture - mealworms live in dark, damp places (III. C-1)

PROCESS/ES: Field Trip

MATERIALS REQUIRED:

Transportation to Destination
Parent Permission Slips

ACTIVITY #25:

Take the class on a field trip to a local feed store. Let the children explore and ask questions to discover some new information about the natural life of the mealworm. Have them find out where the local feed store obtains their mealworms. What are they used for?

Questions:

1. Where do we usually find mealworms?
2. What does a feed store use them for?
3. How do they keep them?
4. How can you prevent them from getting in grain bins?
5. How much damage can they cause?
6. What are some useful purposes for the mealworm?

BEHAVIOR OF MEALWORMS

Grade 2
Self

CONCEPT: Mealworms - their life history

SUBCONCEPT: Mealworm Cultures - mealworms congregate in dark places. (III. C-1)

PROCESS/ES: Inquiry Session

MATERIALS REQUIRED:

None

ACTIVITY #26:

Conduct a type of inquiry session based on the question: "Why do mealworms like dark places?" Have the students gather the facts they know and try to hypothesize a theory for this type of behavior. (Idea: Mealworms hide from enemies in dark places.) How could we test this hypothesis?

Questions:

1. What would happen if a toad is placed together with buried mealworms?

2. How would following walls help protect the mealworm?

3. What does the survival of the mealworm population depend upon?

BEHAVIOR OF MEALWORMS

Grade 2
Self

CONCEPT: Mealworms - their life history

SUBCONCEPT: Mealworm culture will continue to reproduce themselves. (III. C-3)

PROCESS/ES: Observation

MATERIALS REQUIRED:

Mealworms
Bran
Apple
Jars

ACTIVITY #27:

Set up two different mealworm cultures.

1. In jar #1, put some mealworms only.

2. In jar #2, put some mealworms, bran and a piece of apple.

Observe these two cultures for a month's time.

Questions:

1. Which culture do you think will be able to reproduce itself? Why?

2. What does the mealworm need to survive?

3. What has happened in jar #1? Jar #2?

BEHAVIOR OF MEALWORMS

Grade 2
Self

CONCEPT: Mealworms - as member of the insect family

SUBCONCEPT: All insects have certain characteristics. (IV. A-1)

PROCESS/ES: Observation

MATERIALS REQUIRED:

Insect Collection
Magnifying Glasses
Insect Resource Books

ACTIVITY #28:

Have the children collect insects on their own and bring them to school. Supplement their findings with a complete insect collection. Have the students examine the insects for body characteristics:

1. How many legs?

2. How many body parts?

Let the students also use resource books to help find information about the characteristics of insects, such as "Let's Read About Insects." Record the children's findings on the board.

Questions:

1. What is an insect?

2. What are the characteristics of insects?

3. Are all the insects the same?

4. Which ones are different?

BEHAVIOR OF MEALWORMS

Grade 2
Self

CONCEPT: Mealworms - as members of the insect family

SUBCONCEPT: Some insects change as they grow. (IV. A-2)

PROCESS/ES: Observation

MATERIALS REQUIRED:

Mealworms
Grasshoppers (Cage and Grass)
Caterpillars (Box)

ACTIVITY #29:

If possible, have the class collect some small grasshoppers and caterpillars.

1. Put the grasshopper in a cage; feed them grass or leaves. Watch what happens as they grow.

2. Get some caterpillars. Watch them to see if they spin a cocoon or make a chrysalis. Keep the cocoon or chrysalis and find out what adult insect comes from it.

3. Compare these two insects with the development of the mealworm.

BEHAVIOR OF MEALWORMS

Grade 2
Self

CONCEPT: Mealworms - as members of the insect family

SUBCONCEPT: Some insects live alone while some live in large families. (IV. A-4)

PROCESS/ES: Movie Presentation

MATERIALS REQUIRED:

Film - "Insects: How to Recognize Them" (Coronet Films)
Film Projector and Screen

ACTIVITY #30:

Present the film to the class. Have them observe and carefully watch for the different ways that insects live. Have them compare these ways to the living habits of the mealworm.

Questions:

1. What are some different ways that insects live?
2. Which ones live alone? Which ones in large families?
3. Describe the society of the bees?
4. How do beetles live?
5. How does the mealworm live? With others?
6. Do mosquitoes live in large families?

BEHAVIOR OF MEALWORMS

Grade 2
Self

CONCEPT: Mealworms - as members of the insect family

SUBCONCEPT: Like mealworms, mealworm beetles prefer darkness. (IV. B-1)

PROCESS/ES: Experimentation

MATERIALS REQUIRED:

Mealworm Beetles
Black Cloth
White Cloth

ACTIVITY #31:

Have the children take one beetle, a piece of dark cloth and a piece of light cloth. Let the children set-up their own method of experimentation to see if the beetle prefers the dark place or light place. For example, put the beetles in the center of the table; put the cloths some distance from the beetles. Let them move freely in the direction they desire.

Questions:

1. In what direction does the beetle move?

2. Does he prefer the dark or light cloth?

3. Does a beetle hide in bran? Why?

BEHAVIOR OF MEALWORMS

Grade 2
ESS - "101 Simple Experiment with Insects"

CONCEPT: Mealworms - as members of the insect family

SUBCONCEPT: Both mealworms and mealworm beetles prefer warmness (IV. B-2)

PROCESS/ES: Experimentation

MATERIALS REQUIRED:

Mealworm Pupae
Matchboxes
Cotton Wool
Two Thermometers

ACTIVITY #32:

Collect mealworm pupae daily and put them each day into a matchbox with some cotton wool. Write the date on the box. Half the matchboxes are left in a warm place (never exceed 32^{o} C.) and the other half in a cool room (never exceed colder than 14^{o} C.) Count the number of beetles which emerge each day. Compare the time of development in the two groups.

Questions:

1. Does the pupae develop faster in warm areas or in the cold area?

BEHAVIOR OF MEALWORMS

Grade 2
Self

CONCEPT: Mealworms - as members of the insect family

SUBCONCEPT: Mealworm beetles prefer warm areas over cold areas. (IV. B-2)

PROCESS/ES: Observation

MATERIALS REQUIRED:

Mealworm Beetles
Bran
Cloth
Ice
Matches

ACTIVITY #33:

On a surface, place two different piles of bran. One pile should be cold; do this with the ice and a piece of cloth. One pile should be warm; use the matches with this one. Put the beetle in the cold pile of bran; leave him there. How does he react? Now put him near the warm pile; what happens? Do several times and observe the beetles reactions.

BEHAVIOR OF MEALWORMS

Grade 2
ESS - "Behavior of Mealworms"

CONCEPT: Mealworms - as members of the insect family

SUBCONCEPT: Mealworms and beetles both like sides and corners of boxes. (IV. B-3)

PROCESS/ES: Experimentation

MATERIALS REQUIRED:

Mealworms
Box
Mealworm Beetles

ACTIVITY #34:

Place the beetle in the center of the box. Let it go and each time mark its resting place. Do this at least 25 times. (Make sure the box is on a level surface and equally lighted.)

Questions:

1. Which part of the box does the beetle prefer?

2. Is there any change in the climbing methods as the insect changes from mealworm to beetle?

3. How is the change evident?

BEHAVIOR OF MEALWORMS

Grade 2
Self

CONCEPT: Mealworms - as members of the insect family

SUBCONCEPT: Mealworms can be studied easily. (IV. C-3)

PROCESS/ES: Observation

MATERIALS REQUIRED:

Mealworms
Ants
Stimuli Equipment

ACTIVITY #35:

Have the students observe the activity of some ants. Have them use the stimuli equipment and watch them respond. Have the students compare the activity of the mealworm with that of the ant. Why is it easier to observe the mealworm?

SUPPLEMENTARY ACTIVITIES

1. Have a group of children compare the mealworm's behavior with that of other animals and make a report to the class.

2. Have a child set-up and conduct an experiment with the mealworm at home and present his findings to the class.

3. Work individually with a child on an experiment such as "selecting mealworms for weight" and have him write up his findings.

4. Have one child make a detailed drawing of the mealworm, to be used in studying the structure of the mealworm.

5. Have one child grow a culture of mealworms at home, feeding them different kinds of sugar; have him record their development.

6. Have some children construct a T-maze and conduct a series of experiments concerning the reactions of mealworms.

7. Ask a group of children to report on the dark mealworms, what can they find out about them which make them different from the yellow mealworms?

8. Have a child invent an hypothetical animal, describing him in detail. Then, have the child tell the class something about the animal. Let the class devise some experiments which they could do to indicate explanations of this "new" animal's behavior.

9. Ask a child to find out all the information he can obtain on the behavior of the mealworm beetle. How is it different from the mealworm? Have the child share his information during the phase of the unit in which mealworms and mealworm beetles are compared.

10. Have a group of children discuss the significance of what they have learned about the behavior of mealworms in relation to the mealworm's natural life. Let them share their findings with the rest of the class.

11. Have some students write stories about mealworms, if mealworms could talk, how would they describe the experiments that were done on them?

12. Have a group of students review and criticize some of the hypothetical experiments done at the beginning of the unit. Have them relate what they have learned in regard to experimentation, and correct these experiments and statements that are incorrect.

13. Have a group of children construct a letter to be sent home to their parents, in which they explain what type of work they have been doing in science.

BOOKS FOR THE TEACHER

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"Behavior of Mealworms." Elementary Science Study. New York: McGraw Hill, 1966.

Burnett, A. & Eisner, T. Animal Adaptation. New York. Holt, Rinehart, & Winston, 1960.

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*Sources cited for activity cards

BOOKS FOR THE PUPIL

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"Handbook of the Insect World." Delaware: Hercules Powder Company, 1956.

"Insects, Bees, Ants." Little Wonder Books. Merril, New York.

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*Ware, Kay. Let's Read About Insects. St. Louis: Webster Publishing Company, 1957.

Zim. Herbert, Insects. (Golden Nature Series) New York: Golden Books, 1964.

PICTURES FOR THE PUPIL

ESS - "Behavior of Mealworms" 6 - Black and White Pictures

To obtain the pictures, write directly to:

Science Product Manager
Webster Division, McGraw Hill Book Company
Manchester Road
Manchester, Missouri 63011

*Sources cited for activity cards

AUDIO-VISUAL AIDS

Filmstrips:

Ants at Work and at Play - True-Life Adventure Series
Color

How Insects Live and Grow - Society for Visual Education
Color

Learning About Insects - Encyclopedia Britannica
Color

Insects and Their Ways - Society for Visual Education

Insects: How They Live and Grow - Encyclopedia Britannica

Insect Life Cycles - Encyclopedia Britannica

Films:

Beetles - Coronet Films
Color (11. min.)

How Insects Help Us - Coronet Films
Color (11. min.)

Insect Enemies and Their Control - Coronet Films
Color (11. min.)

Insects: How to Recognize Them - Coronet Films
Color (11. min.)

Microscopic Mysteries: Insect Life - Teaching Film Custodians
Black & White (10. min.)

SCIENCE EQUIPMENT AND SUPPLIES

1. Mealworms - for a class of 30, it would be best to obtain 300 mealworms for the start of the unit and order 300 more after several weeks.

2. Bran - a few pounds of bran or several boxes of dried breakfast cereal flakes.

3. Large Jar - a jar, can, or wooden box with a glass cover can be used for housing the mealworms.

4. Sandwich Bags - waxed-paper sandwich bags can be used to carry the mealworms home; 50 are probably needed.

5. Magnifying Glasses or Microscopes - a simple hand lens works well for observing the mealworms.

6. Metrome or Homemade Time Keeper - these will be used when time must be watched during an experiment.

7. Materials for Constructing Walls:

   Strips of Wood and Plastic
   Cardboard
   Heavy Construction Paper
   Aluminum Foil
   Transparent Plastic Wrapping
   Masking Tape
   Transparent Mending Tape
   Wire
   Knives
   Scissors
   Hammer
   Nails

8. Other Common Supplies:

   Paper Clips
   Straws
   Rulers
   Chalk Dust
   Sawdust
   Cellophane
   Matches

Flour
Beaker
Thermometer
Mirror
Plastic Box
Pin
Vinegar
Glue
Plastic Tubing
Colored Paper
Match Boxes
Flashlight
Shoe Boxes
Plastic Bottle
Black and White Cloths
Fluorescent Paint
Large Box
Water
Little Jars
Board
Sheeting
Eye Droppers
Toothpicks
Apple
Cotton Wool

	First Week	Second Week	Third Week
Monday	Introduce unit - study of an unfamiliar animal Observe animal's response to stimuli What kind of animal?	Discuss - general pattern of locomotion of mealworm Question: How can we answer them? Activity #7	Activity #12 Record results Present data Discuss (Following walls)
Tuesday	Discuss - the type of animal - mealworm Study general body structure Activity #1	Individual - determine pattern to be tested Discuss - materials Data sheet Devise quality of experiment to be used	Review: What are the eating habits of mealworms? Set-up Activity #14 Observation (Carbohydrates)
Wednesday	Describe behavior of mealworm Record this data Demonstrate exper. procedure Activity #4 (Sensitivity to heat)	Experimentation Activity #8, #9, #10 Combine results Conclusions (Smooth surface vs. rough surface)	Class demonstration Activity #15 Discuss Worksheet Work on notebooks Record findings and new information
Thursday	Design an experimental procedure - determine care of mealworms Steps which are involved Identify processes of experimentation (Dietary requirements)	Question: How does a mealworm react to walls? Develop hypothesis Methods of testing Ideas for equipment Materials needed	Activity #16 Present data Individual test for Friday Preparation (Discovering food source)
Friday	Perform experiment work in groups Activity #5 Compare results Start mealworm notebooks (Food choices of worm)	Construct walls for Activity #12 Group work or indiv. Creativity stressed Safety rules with equipment	Discuss: What should we know about the environment of mealworms? Activity #17, #18, #19, #20 Partners or groups